DOCUMENT RESUME

ED 452 367 CE 081 628

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TITLE Women and Minorities in High-Tech Careers. ERIC Digest No. 226.
INSTITUTION ERIC Clearinghouse on Adult, Career, and Vocational Education, Columbus, OH.
SPONS AGENCY Office of Educational Research and Improvement (ED), Washington, DC.
REPORT NO EDO-CE-01-226
PUB DATE 2001-00-00
NOTE 4p.
CONTRACT ED-99-CO-0013
AVAILABLE FROM For full text: http://www.ericacve.org/fulltext.asp.
PUB TYPE ERIC Publications (071) -- ERIC Digests in Full Text (073)
EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS Attitude Change; *Career Education; Change Strategies; Community Colleges; Computer Attitudes; *Education Work Relationship; Educational Change; Educational Environment; Educational Policy; Educational Technology; Elementary Secondary Education; Employed Women; Employment Patterns; Equal Education; Information Needs; Job Training; Leadership; Literature Reviews; *Minority Groups; Needs Assessment; *Nontraditional Occupations; Recruitment; Role Models; Sex Fairness; *Technical Occupations; Technological Advancement; Trend Analysis; Two Year Colleges; Vocational Education; *Womens Education
IDENTIFIERS ERIC Digests

ABSTRACT

Women and minorities are underrepresented in technology-related careers for many reasons, including lack of access, level of math and science achievement, and emotional and social attitudes about computer capabilities. Schools and teachers can use the following strategies to attract women and minorities to high-tech careers and prepare them for work: (1) connect technology to female and minority students' interests; (2) work to change social attitudes; (3) involve business in developing the skills needed for high-tech occupations; and (4) provide career information. Collaborative and cooperative learning environments are additional effective teaching strategies for technology learning because they promote learning through social interaction with others. Additional strategies for increasing female and minority students' interest in technology are to introduce technology in the middle grades and provide mentors and role models. Schools can facilitate gender equity and leadership development by employing the following policies: (1) select software free of gender and ethnic bias; (2) ensure that computer laboratories are accessible to each gender, ethnic group, and income level, as well as to students with disabilities; (3) encourage the incorporation of technology strategies within all sectors of the curriculum; (4) provide staff training in technology; and (5) periodically review and revise equity policies as necessary. (Contains 15 references.) (MN)

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CE081422P

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ERIC Digest No. 226

Women and Minorities in High-Tech Careers

by Bettina Lankard Brown
2001

ED-CE-01-226

Women and minorities are underrepresented in technology-related careers. Lack of access, level of math and science achievement, and emotional and social attitudes about computer capabilities may be some of the factors that cause women and minorities to avoid high-tech careers. According to the American Association of University Women, the number of women graduating in computer sciences and information technology is decreasing despite the increased need for workers in these areas (Friedman 2000). The Bureau of Labor Statistics reports that only 7.2 percent of all computer scientists are African American and 2.6 percent Hispanic (Bruno 1997). Because employment in today's workplace requires increasingly sophisticated technological skills, educators must find ways to recruit and retain all types of students in math, science, and technology (MST) courses. This **Digest** presents a number of ways that schools and teachers can attract women and minorities to high-tech careers and prepare them for work.

Attracting Women and Minorities

A common reason that young people become attracted to a career field is that the career appeals to their intellect and emotions: they are intellectually aware of the benefits of the work and emotionally committed to the work because of its personal relevance to their lives. Following are four strategies for initiating and sustaining students' intellectual and emotional interest in pursuing a career in technology.

Connect Technology to Their Interests

Integrating technology into a variety of subject areas—e.g., music, history, art, and science—can be a stimulus for learning. Not only can it expand students' knowledge of technology concepts, but it can also engage students in the learning process by including opportunities for problem solving and creative thinking regarding technology use ("Girls Missing Out" 2000). Hands-on applications and reality-based assignments are activities that can be highly motivational as they enable students to learn technology in the context of its real-world application (Smith 2000).

Designing curriculum that is attentive and responsive to diverse cultural orientations can also be a motivator when introducing technology. Harrington (1998) notes that many African Americans are drawn to careers that offer direct service to their communities—such as education, social work, medicine, law, and religion. For technology to be appealing to people of all cultures, educators must be able to connect technology-related careers to cultural values.

Gaming can be used to stimulate student interest in technology when the games are free of gender bias and designed to appeal to both sexes. Because games are viewed as "play," they can engage students in problem solving in a relaxed atmosphere, thus helping students to develop skills without fear of risk taking. Low-threat, high-challenge play and cognitive activities have proven to be motivational influences for learning.

Change Social Attitudes

According to the National Science Foundation, the number of females receiving bachelor's degrees in computer science dropped from 40% to 27.5% between 1984 and 1996 (Radcliff 1999). One factor contributing to this downturn may be that girls view people who work in technology as having solitary jobs that involve little interaction with other people. To change social attitudes regarding women's needs and abilities regarding technology, El Paso Community College established the Women in Technology (WIT) program. The WIT program offered technical education services for women and engaged in community outreach efforts, which included female mentors from the community. After 10 years in operation, female enrollment in technical fields at El Paso Community College has more than doubled (DiBenedetto 1999).

Some educators feel that schools have unknowingly contributed to the limited enrollment of minorities in classes that would prepare them for high-tech careers. Ramirez, Laurel, and Rodriguez-Aguilar (1999) advocate the use of intervention activities in mathematics and science in the elementary and middle grades. Harrington (1998) suggests that career counselors become more open to the technological potential of minorities, ensuring that they do not allow prejudicial thinking to keep them from offering appropriate career guidance.

Involve Business

Businesses have a vested interest in wanting to help students develop the technological skills required for work in this century. They need workers who can complete complex tasks by using these skills as well as problem solving and critical thinking. As a result, many businesses are offering incentives to young women and minority students. Intel Corporation, for example, recently established a Computer Clubhouse in cooperation with Boston's Museum of Science and the Massachusetts Institute of Technology Media Lab. In this after-school program, female and minority youngsters meet with adult mentors to learn more about computer technology. "Intel plans to open 100 such clubhouses around the world by 2005" (Bruner 2000, p. 14). Microsoft Corporation, IBM, and AT&T have demonstrated a commitment to helping Black students become interested in high tech by promising $101 million in cash and equipment to 39 Black schools. Initiating the United Negro College Fund drive with this commitment, the three high-tech companies are hoping to close the gap that separates minorities from the high-tech economy ("Microsoft" 2000).

Provide Career Information

"The *Occupational Outlook Quarterly*, which forecasts employment trends through the year 2005, predicts the demand for computer scientists and systems analysts will grow by 111 percent between 1992 and 2005" (Caruso 1997, p. 6). Jobs in these fields offer great potential for job security and higher salaries. Unfortunately, many female and minority students are unaware of these projections, especially in the job market for computer engineers, systems analysts, and webmasters. However, giving students this information is meaningless if it is not accompanied by real-world experiences of observing or talking with people who work in these professions. George K. Williams of TRW Systems & Information Technology Group has been working with the Black Data Processing Associates to help bridge the racial divide. Williams said their most effective strategy involved "going into the schools and sharing our knowledge about computer technology while serving as mentors and role models" (Alter and Severin 2000, p. 49).

Preparing for High-Tech Careers

"The American Electronics Association finds that the total number of degrees awarded in engineering technology declined 16 percent between 1990 and 1996. Of the decreasing number of high-tech

degrees awarded, foreign nationals received 45 percent of the PhDs and 32 percent of the master's....The U.S. educational system is not adequately preparing our youth for today's information age economy" (Wolff 1999, pp. 7-8). Following are some steps educators can take to improve their methods for preparing women and minorities for high-tech employment.

Change Teaching and Learning Practices

Collaborative and cooperative learning environments are effective teaching strategies for technology learning because they promote learning through social interaction with others. They reflect the constructivist learning theory, which contends that true learning occurs as individuals share their knowledge and interact with each other in the social environment of its application. The purpose for learning must extend beyond the classroom and link to everyday life for the acquired knowledge to have real meaning to the learner. Collaborative learning practices encourage interdependence and a sense of shared responsibility, as opposed to individual learning, which rewards leadership through dominance (Ramirez et al. 1999).

Introduce Technology in Middle Grades

Educators are recognizing the importance of involving girls and minorities in technologies at an early age, when they are motivated by their own interests and not influenced by stereotypical views of career choices. The Girl Scouts of America show their support of this view by offering proficiency badges in technology and the Internet for Brownie, Junior, and Senior levels (Radcliff 1999). As at higher levels of schooling, the programs at the middle grades should be engaging and interactive. They should be designed to promote creativity, yet provide structure so that students can relate information technology to their lives (Alter and Severin 2000).

The Brownsville Independent School District has experienced success in increased minority participation through its school year and summer programs. Of the district's 40,000 K-12 students, 97 percent are Hispanic. Teacher training, curriculum reform, policy analysis, and student activities were introduced "as part of a comprehensive plan to prepare and recruit minority students into the science, mathematics, engineering, and technology pipeline" (Ramirez et al. 1999, p. 14). A 5-year study of the program found that student proficiency in science and mathematics increased (ibid.).

Provide Mentors and Role Models

Providing role models and mentors for female and minority students is another way to increase their interest in technology careers. In a study of 12 women successfully employed in nontraditional, technology-related professions, many reported being "influenced by either an encouraging male figure within their personal sphere, and/or by a teacher in the educational sphere" (Smith 2000, p. 4). Many participants commented that exposure to a strong female technological role model played a significant part in their choosing MST career paths.

The Department of Mathematics and Computer Science and Office of Multicultural Affairs at Fontbonne College in Missouri matched eight high-risk first- and second-year students with alumni mentors as part of a one-credit career management course. Evaluation of the effort showed improved academic student performance (Newton and Wells-Glover 1999).

Demonstrate Commitment to Equity

Schools can facilitate gender equity and leadership development by employing the following policies (Quilling 1999, p. 72):

- Selecting software free of gender and ethnic bias.
- Ensuring that computer laboratories are accessible to each gender, ethnic group, and income level, as well as students with disabilities.
- Encouraging the incorporation of technology strategies within all sectors of the curriculum.
- Providing staff training in technology.
- Periodically reviewing and revising equity policies as necessary.

These strategies provide structured norms that emphasize equity in technology usage and foster relationships that help students achieve their career goals (ibid.).

Conclusion

Research has shown that many of the barriers to science, mathematics, engineering, and technology careers may be overcome by effective school practices. Teaching and learning practices, early intervention programs, and mentoring are just some of the ways schools can foster student participation in high-tech programs and careers. Eliminating, or at least reducing, the social and educational factors that have created barriers to high-tech careers can help educators to move new generations of female and minority students into the high-tech careers in which they have been underrepresented.

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This project has been funded at least in part with Federal funds from the U.S. Department of Education under Contract No. ED-99-CO-0013. The content of this publication does not necessarily reflect the views or policies of the U.S. Department of Education nor does mention of trade names, commercial products, or organizations imply endorsement by the U.S. Government. *Digests* may be freely reproduced and are available at <http://ericacve.org/fulltext.asp>.

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